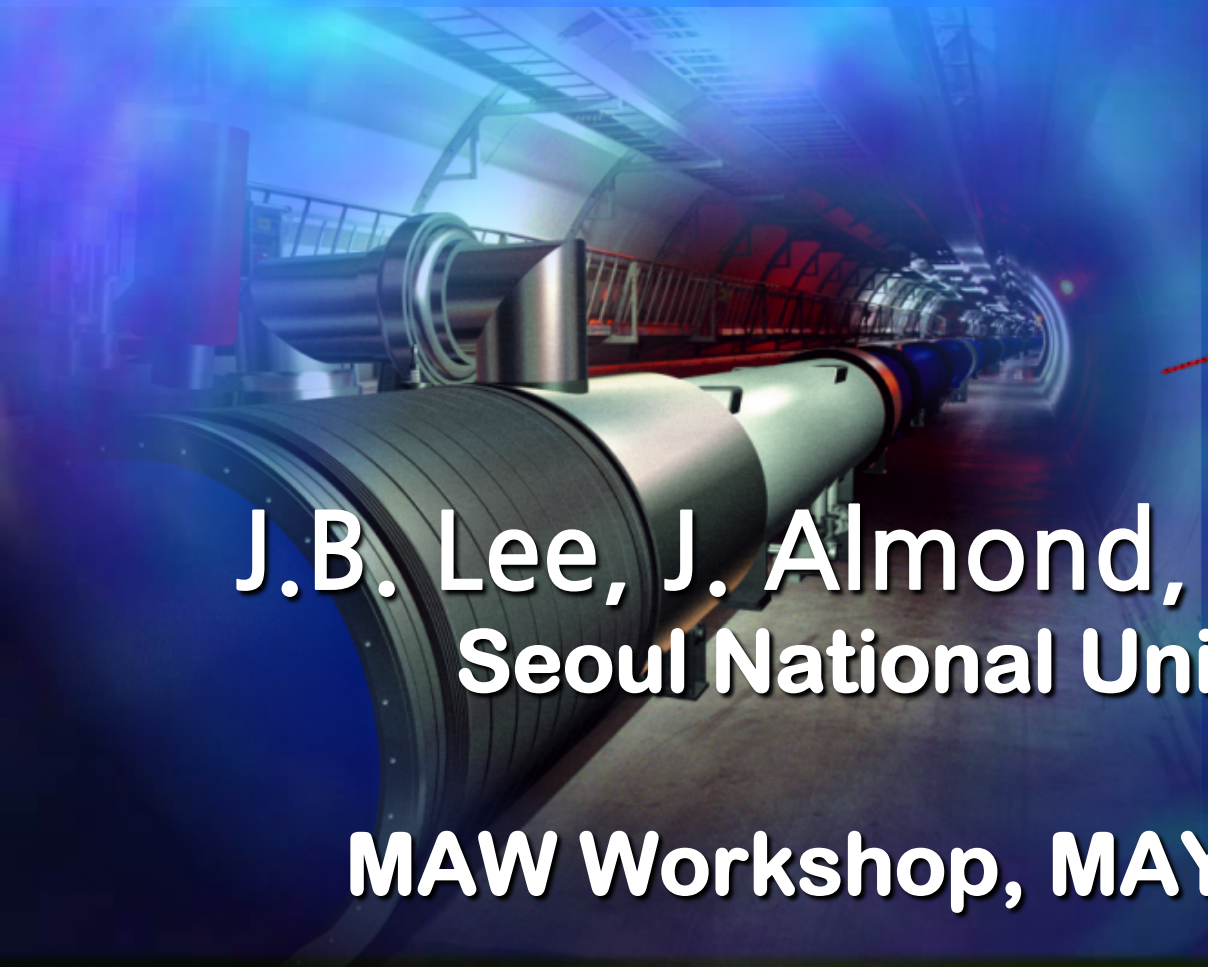
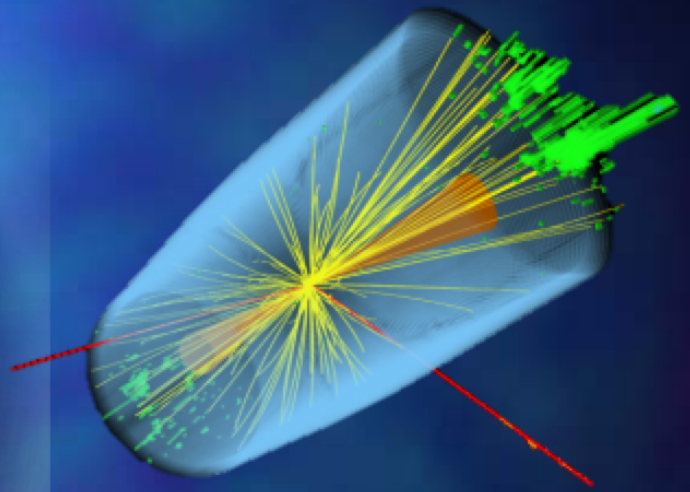
Anomalous Dimuon Production inside b-jets at CMS





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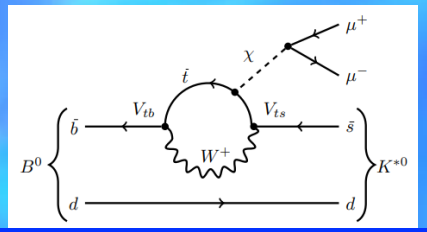
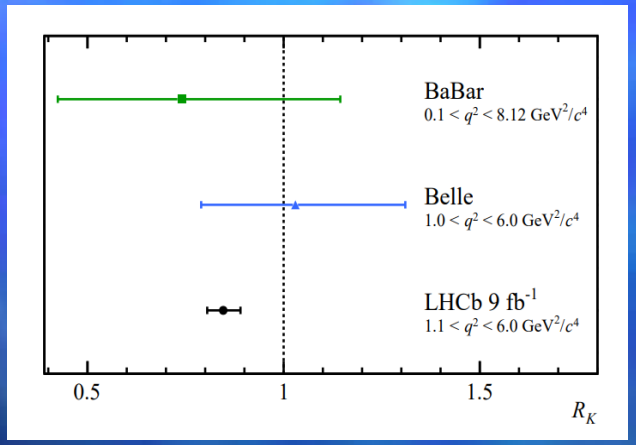
Seoul National University

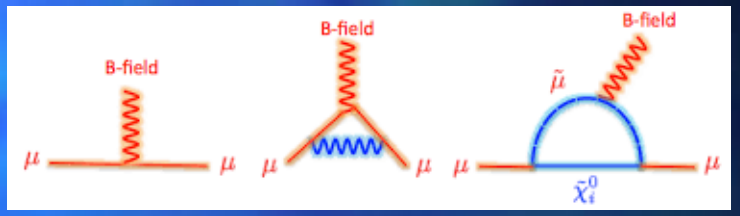
MAW Workshop, MAY 21, 2021

Interesting anomalies…

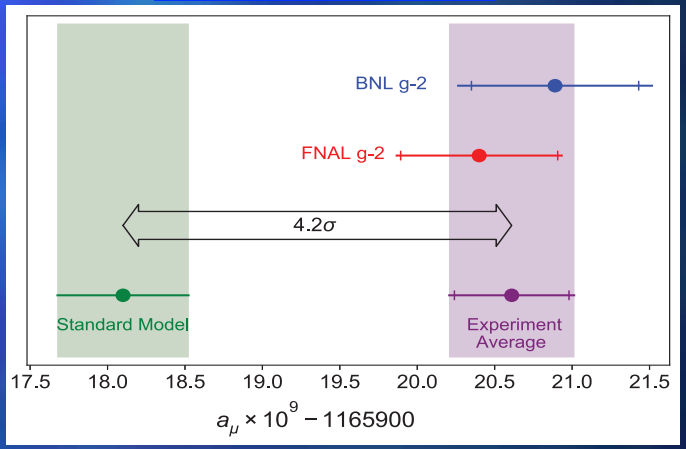


LHCb: Lepton Flavor Violation (LFV)





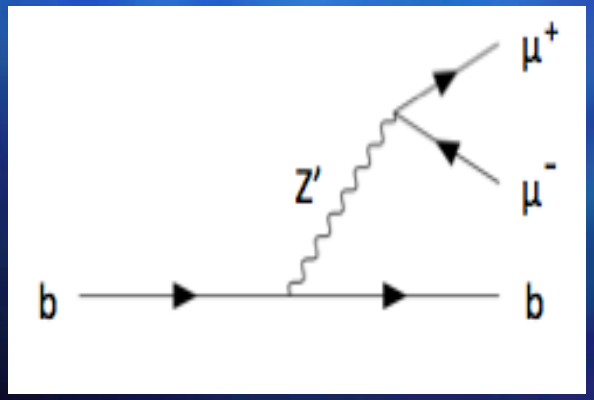
FNAL g-2

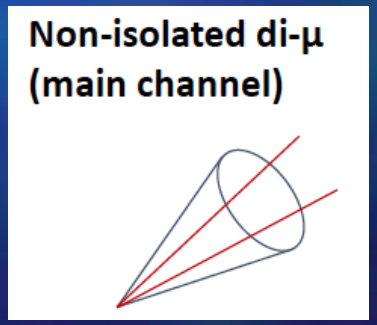


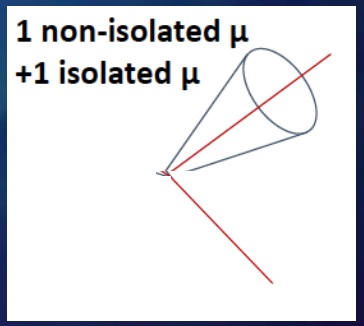
- **LHCb**의 **LFV**와 **FNAL**의 **g-2** 결과 모두 뮤온과 **b-quark**과 관련하여 진공에서 새로운 상호작용을 가능성을 제시
- 새로운 방법으로 **g-2**를 측정하는 것이 중요: **JPARC g-2**
- **LHC**에서 새로운 방식으로 탐색을 모색

Anomalous dimuon production

- **Non-isolated dimuon inside b-jets**
  - Searches for new physics have been performed by isolated dimuons or long-lived muons
  - Muons inside jets ("non-isolated") are mostly from QCD bkgds, thus they have been ignored
  - Exotic dimuon production (from psedu-scalar particle) highly coupled with heavy b-quark can occur

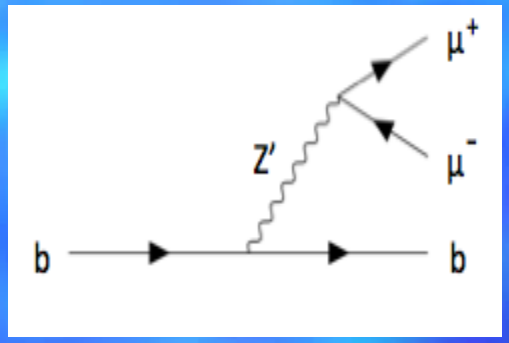


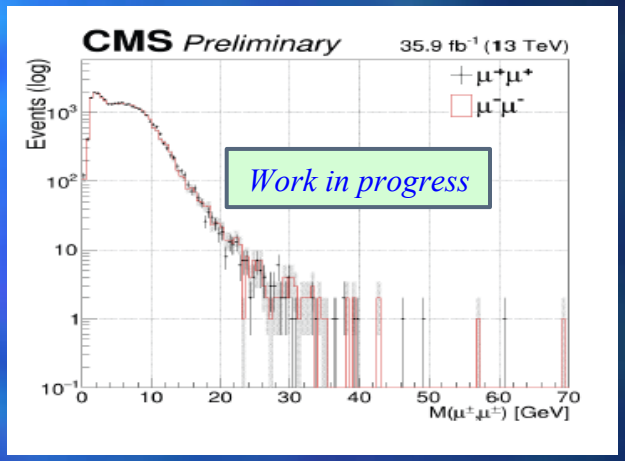




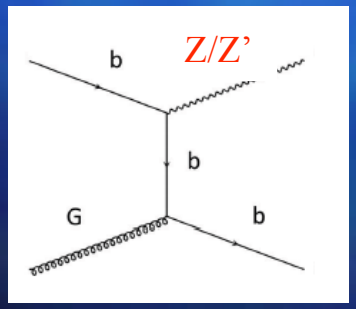
Anomalous dimuon production

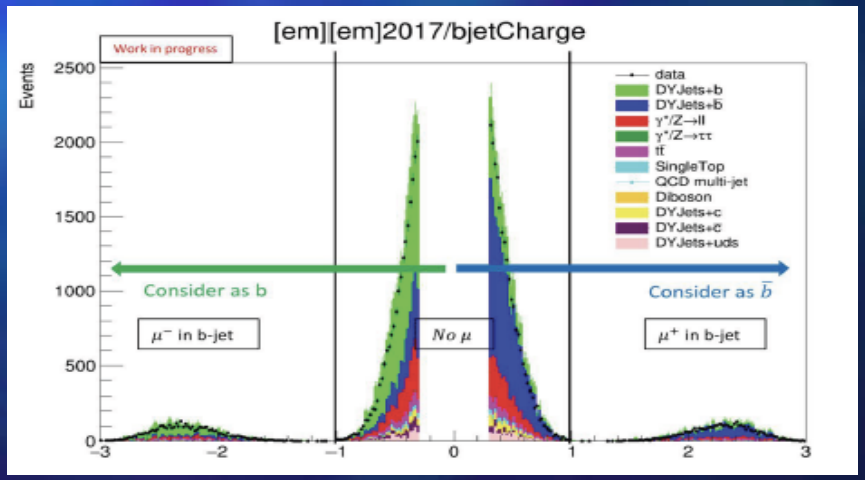
- Search for anomalous dimuon production inside b-jet





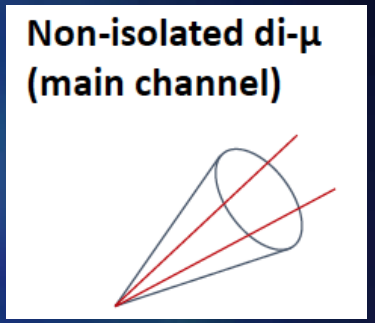
- Single b-jet + dilepton: LFV, forward-backward asymmetry



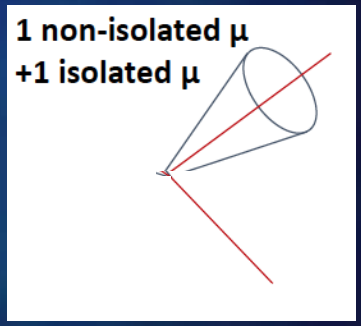


Dimuon events inside jets

- Trigger: dimuon trigger without isolation (Pt: 30, 11 GeV)
- Muon: Pt>32, 13 GeV, |eta|<2.4, anti-isolation: iso>0.3
- Jet: Pt>30 GeV |eta|<2.4
- One jet with two muons, del(jet, μ)<0.3

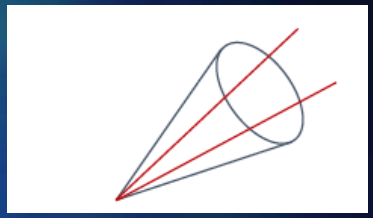


- Search Strategy
  - Background study:
    mainly by using light-jets
  - Look for interesting signature
    with '2016 data only,
    and then full results with all Run II data

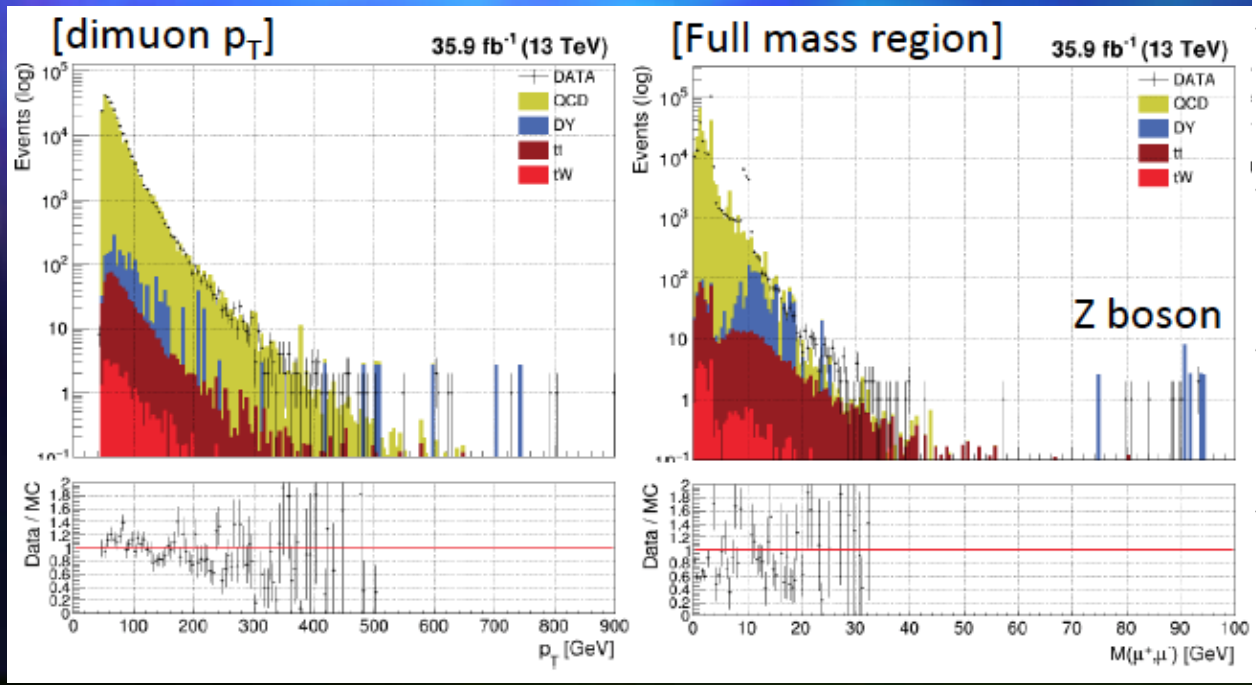


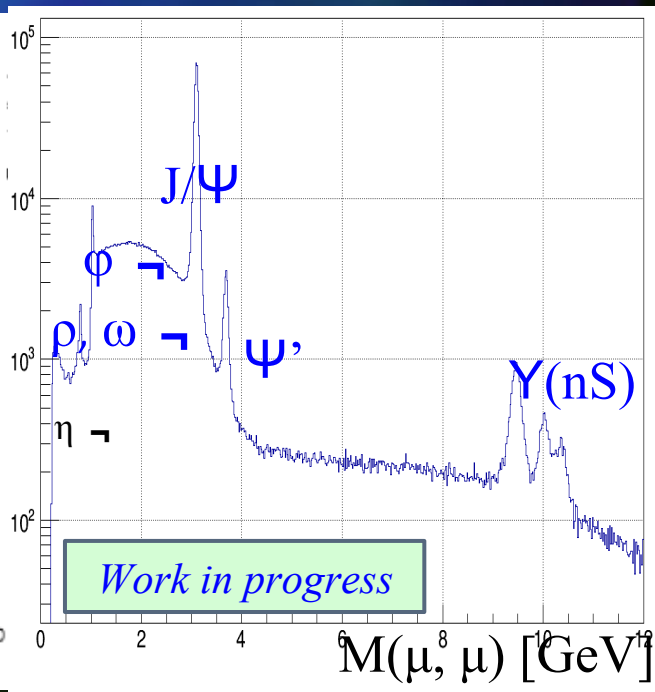
OS dimuon events inside jets

- OS dimuon events with b-jet veto
  - Check the QCD backgrounds



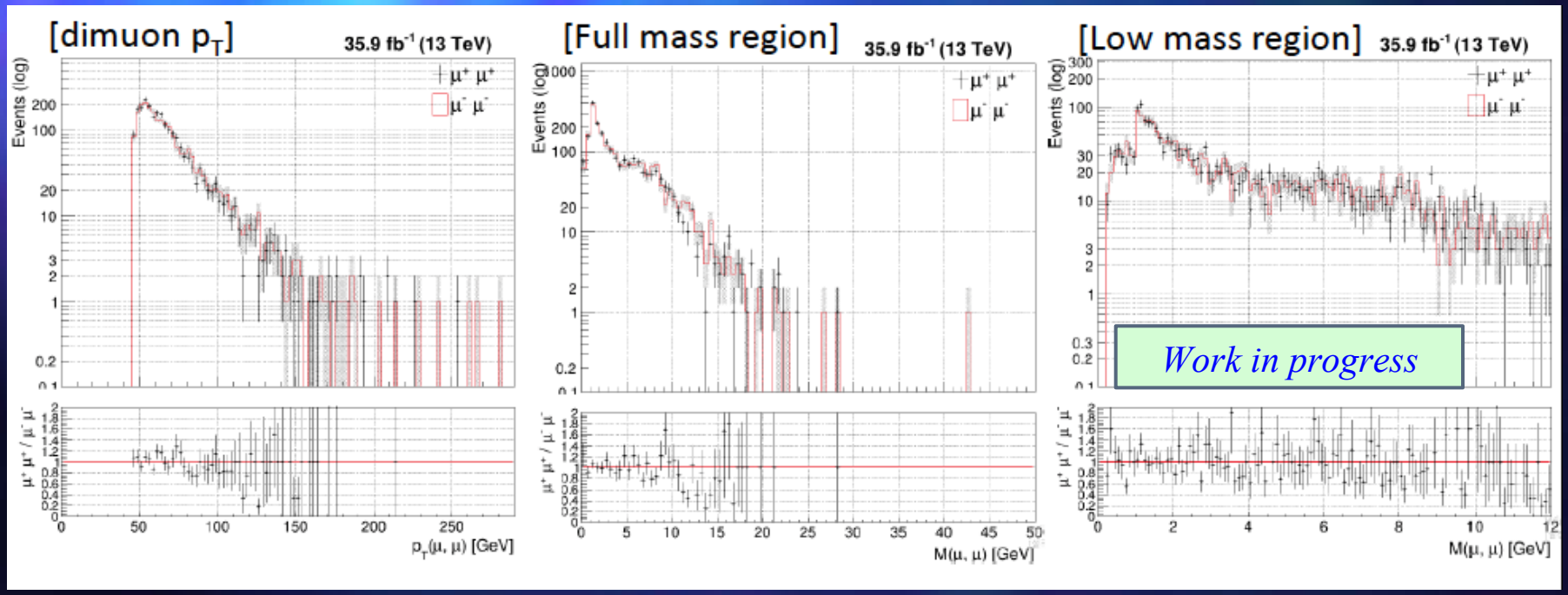
- OS dimuon distributions looks ok





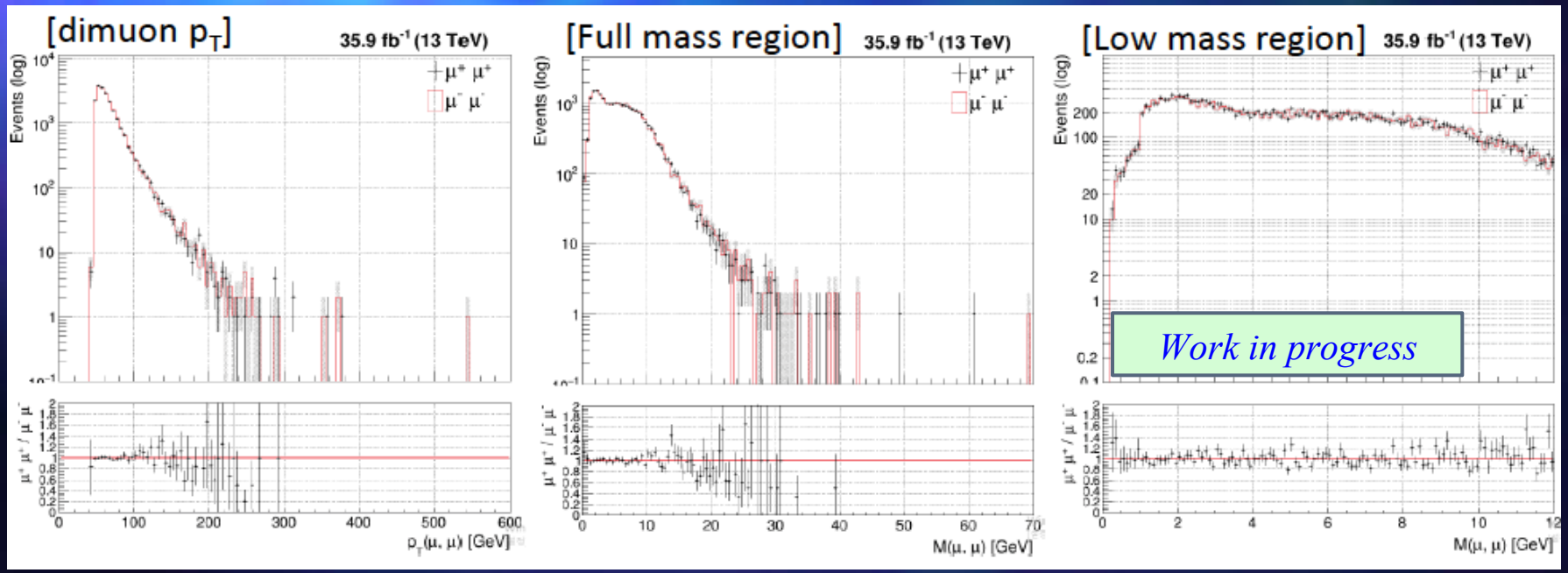
SS dimuon events inside jets

- SS events ($\mu^+\mu^+$ vs $\mu^-\mu^-$) inside b-jet
  - Check same-signed (SS) dimuons from QCD
  - Any hint for CP violation using asymmetry
  - Any hint for double-charged particle?
- Check the SS events with light-jet data



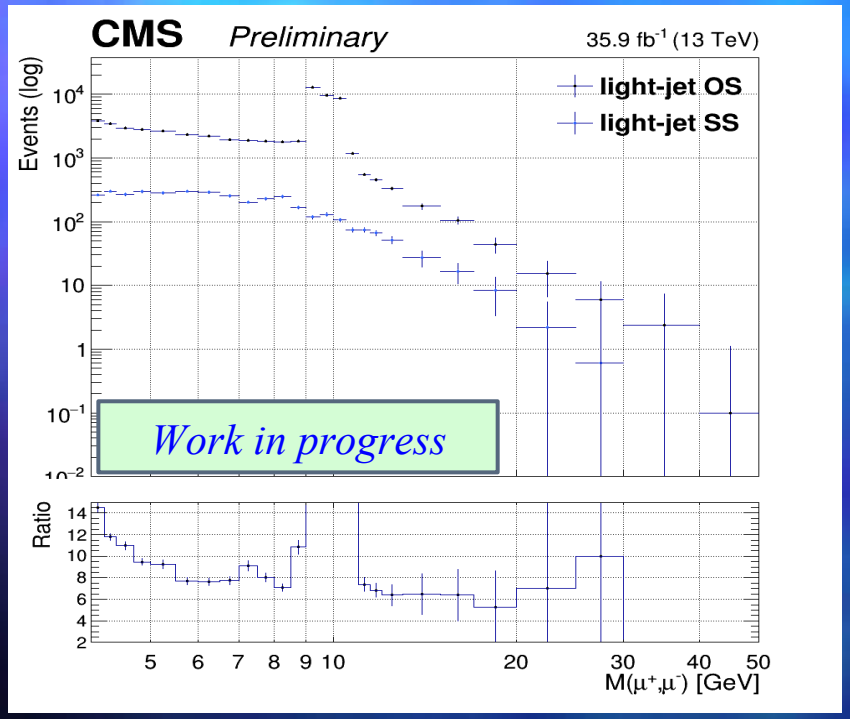
SS dimuon events inside jets

- Any anomalous SS dimuon with b-jet?
- SS events ($\mu^+\mu^+$ vs $\mu^-\mu^-$): good agreement between ++ and -- events
- Asymmetry beween ++ and -- are not shown

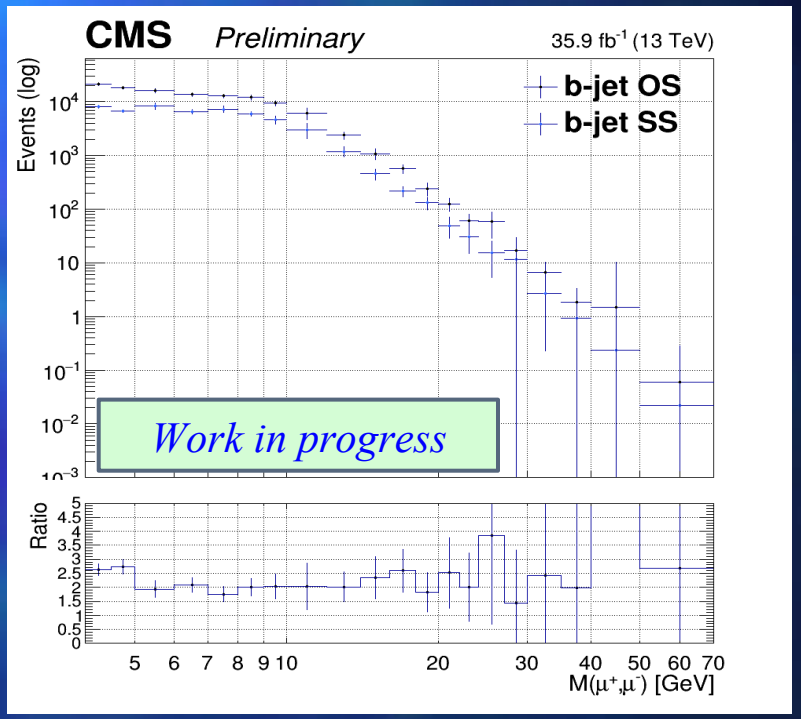


Dimuon (SS vs OS)

Light-jet (data) with b-jet veto)

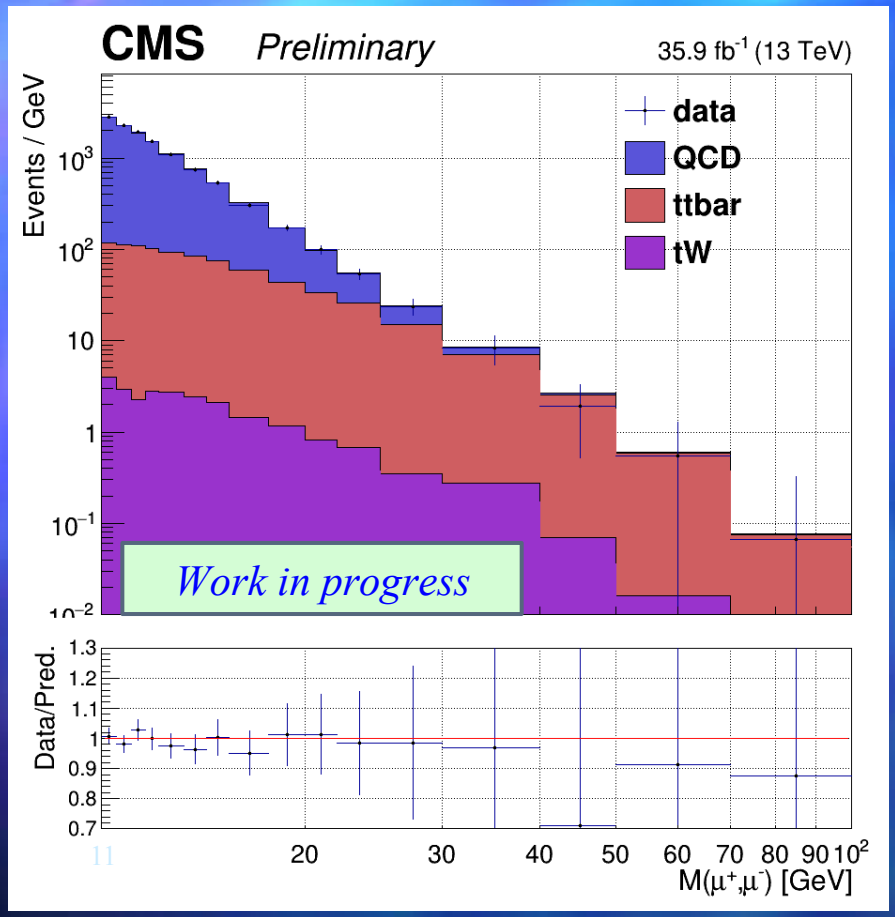


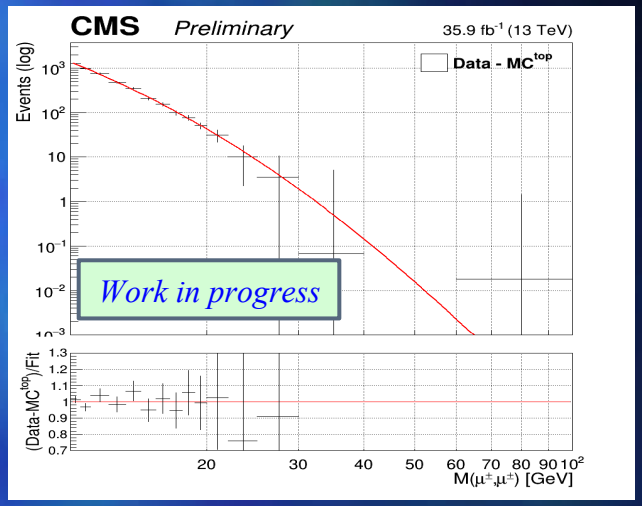
QCD MC with b-jets



➢ SS & OS: same dimuon mass distributions

Dimuon mass (OS) inside b-jet



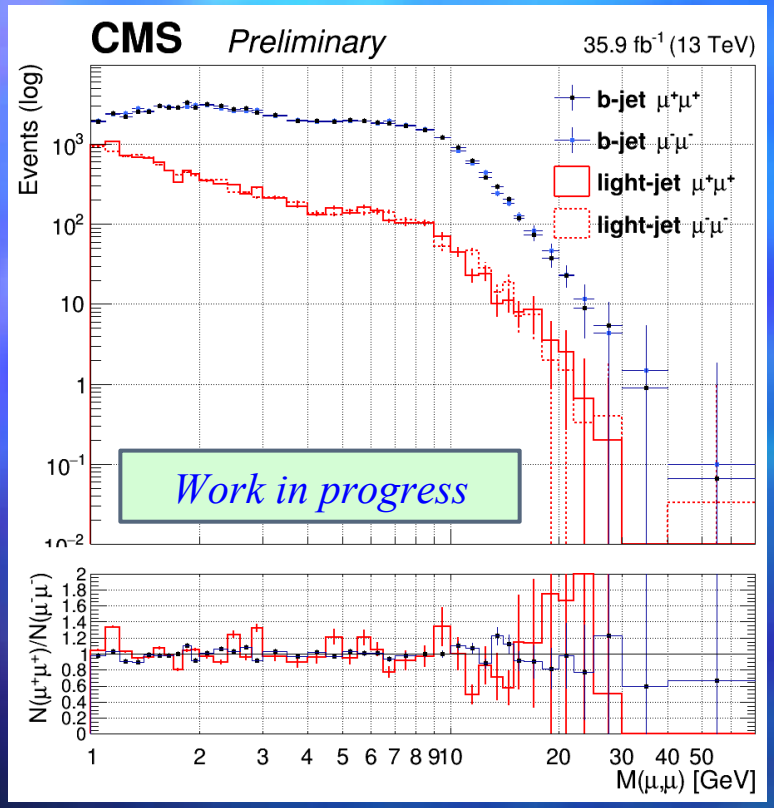


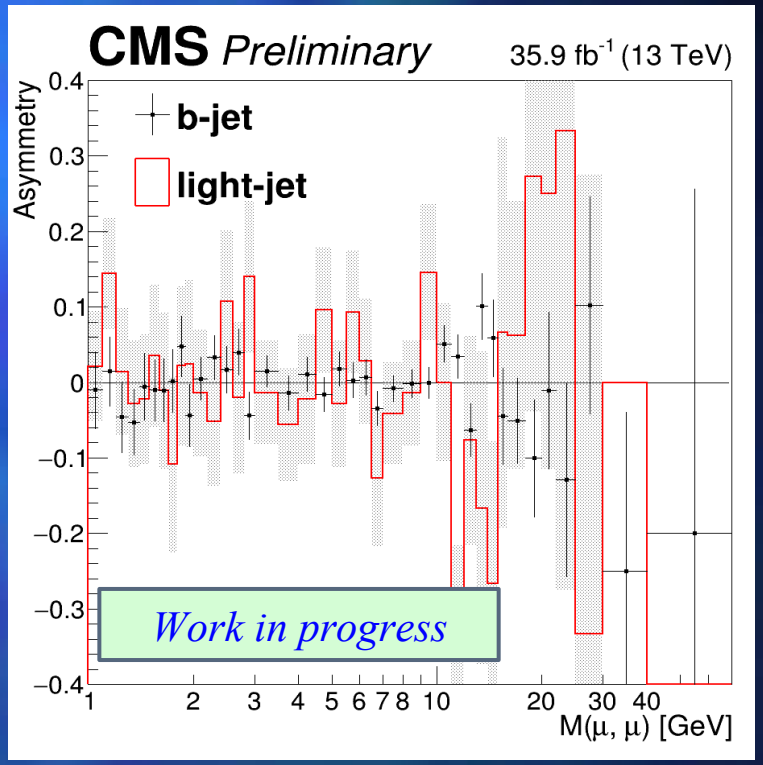
- QCD shape (OS) is extracted from the SS dimuon inside b-jet and it is parameterized.
- Normalization by the total OS/SS events for m(ll)>12 GeV

- Data are in good agreement with the SM predictions

SS dimuon charge asymmetry

- Asym. = { N($\mu^+\mu^+$) – N ($\mu^-\mu^-$)} /{ N($\mu^+\mu^+$) + N ($\mu^-\mu^-$)}

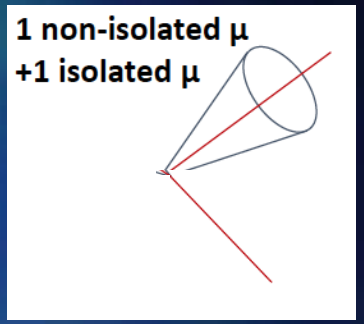


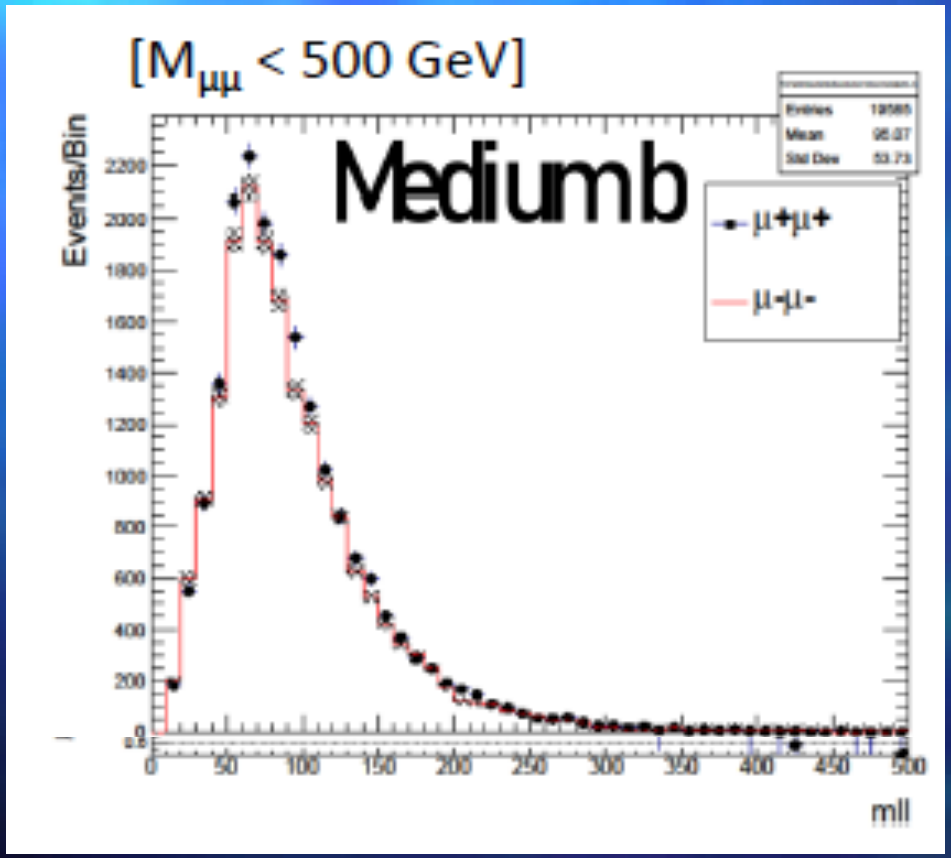


- SS ($\mu^+\mu^+$ vs $\mu^-\mu^-$): same mass distribution for b-jet and light jets
- No charge symmetry appeared

Dimuon with 1 non-iso muon

- Single lepton trigger
- Muon: Pt > 26 (iso), 20 GeV (non-iso)





Summary

- We have studied dimuon events inside jets
  - Same signed dimuon events (++ & --) are found to have the same invariant mass distribution

    inside light jet or b-jets
  - No anomalous SS dimuon events are shown inside jets
  - No charge asymmetry between (++) and (--) shown
  - OS and SS events from QCD backgrounds are found to have the same invariant mass distributions

- We plan to set the limit on the anomalous dimuon production inside b-jet
- We plan to study various asymmetry in dimuon from b-jet